

WHAT IS CLAIMED IS:

1. A conveyor for conveying a metal work piece from a supply source to a loading/unloading position adjacent to and between a die and a punch in a forging apparatus and for conveying a forged product from the loading/unloading position to a storage area, said conveyor comprising:

a pivot assembly and a moveable robot arm having an end effector fixed to one end thereof and an opposite end of said robot arm attached to said pivot assembly for movement about a first axis;

a servo actuator and a crank arm connected at one end thereof to said servo actuator and at an opposite end to said pivot assembly for rotating said robot arm about said first axis in response to movement of said servo actuator and means for controlling movement of said servo actuator;

said end effector including first and second carrier elements with said first carrier element fixed to said robot arm and said second carrier element pivotally connected to said first carrier element for rotation about a second axis and said first and said second carrier elements adapted to receive a work piece therebetween when in a closed position;

said second of said carrier elements including a concave upper portion adapted to receive a forged product thereon when in a closed position and an outwardly extending finger;

an unloading actuator for engaging said outwardly engaging finger as said robot arm rotates about said first axis to move said second carrier element into an unloading position to deliver the forged product to a storage area, and means for returning said second carrier element to its closed position after delivery of said forged product.

2. A conveyor for conveying a metal work piece from a supply source to a loading/unloading position adjacent to and between a die and a punch in a forging apparatus and for conveying a forged product from the loading/unloading position to a storage area, said conveyor according to Claim 1 in which said means for returning said second carrier element to its closed position is gravity actuated.

3. A conveyor for conveying a metal work piece from a supply source to a loading/unloading position adjacent to and between a die and a punch in a forging apparatus and for conveying a forged product from the loading/unloading position to a storage area, said conveyor according to Claim 1 in which said means for retaining said second element to its closed position is an offset weight.

4. A conveyor for conveying a metal work piece from a supply source to a loading/unloading position adjacent to and between a die and a punch in a forging apparatus and for conveying a forged product from the loading/unloading position to a storage area, said conveyor according to Claim 1 in which said means for returning said second element to its closed position is a spring.

5. A conveyor for conveying a metal work piece from a supply source to a loading/unloading position adjacent to and between a die and a punch in a forging apparatus and for conveying a forged product from the loading/unloading position to a storage area, said conveyor according to Claim 1 in which said moveable robot arm is J-shaped.

6. A conveyor for conveying a metal work piece from a supply source to a loading/unloading position adjacent to and between a die and a punch in a forging apparatus and for conveying a forged product from the loading/unloading position to a storage area, said conveyor according to Claim 5 in which said first and second carrier elements define an opening for encircling a generally cylindrical work piece in sliding engagement therewith whereby a press punch can push the work piece out of the end effector and into a die.

7. A cold forging apparatus for performing multiple functions at a single station to form complex shapes, said apparatus comprising:

a first multiple punch assembly including a first inner punch and a first outer punch moveable along a common axis with respect to one another, a third moveable punch moveable along a second axis which intersects with said first common axis and means for moving said punches individually along their respective axes, and means for positioning a die between said first multiple function punch assembly and said third moveable punch for

receiving and containing a work piece, a programmable logic controller, multi axis controller and a feed back device for controlling movement of said punches along the first and second axes, said apparatus also including a loading/unloading position between said first multiple punch assembly and said third punch, and a conveyor for conveying a metal work piece from a supply source to said loading/unloading position and for conveying a forged product from said loading/unloading position to a storage area and wherein the movement of said conveyor is controlled by said feed back device and wherein the work piece is moved into said die by one of said punches and a forged product is moved out of said die and onto said second carrier element by one of said punches.

8. A cold forging apparatus for performing multiple functions at a single station to form complex shapes, said apparatus according to Claim 7 in which said first inner punch is surrounded by said first outer punch and in sliding engagement therewith.

9. A cold forging apparatus for performing multiple functions at a single station to form complex shapes, said apparatus according to Claim 8 in which said conveyor includes a first pivot assembly and a moveable robot arm having an end effector fixed to one end thereof and on said opposite end of said robot arm attached to said pivot assembly for rotation about a third axis and means including a servo actuator for rotating said robot arm about said third axis and in response to movement of said servo actuator and wherein said movement of said servo actuator is controlled by said feed back device.

10. A cold forging apparatus for performing multiple functions at a single station to form complex shapes, said apparatus according to Claim 9 wherein said means including a servo actuator for rotating said robot arm includes a crank arm connected at one end thereof to said servo actuator and at its other end to said robot arm.

11. A cold forging apparatus for performing multiple functions at a single station to form complex shapes, said apparatus according to Claim 10 which includes a storage tray for forged products and in which said second carrier element includes a concave surface and an outwardly extending finger and is adapted to receive a forged product pushed out of said die

and onto said concave surface and to convey said forth product to said storage tray and means for engaging said outwardly extending finger to tilt said second carrier element to thereby deliver the forged product to said storage tray.

12. A cold forging apparatus for performing multiple functions at a single station to form complex shapes, said apparatus comprising:

a first multiple punch assembly including a first inner punch and a first outer punch moveable along a first common axis with respect to one another, a second moveable punch assembly including a second inner punch and a second outer punch moveable along said common axis in a confronting relationship with said first punch assembly, and means for moving said punches individually along said common axis, and means for positioning a die between said first multiple punch assembly and said second multiple function punch assembly for receiving and containing a work piece, a programmable logic controller, multi axis controller and means including a feed back device for controlling movement of said punches along said axis;

said apparatus also including a loading/unloading position between said punch assemblies and a conveyor for conveying a metal work piece from a supply source to said loading/unloading position and for conveying a forged product from said loading/unloading position to a storage area and wherein the movement of said conveyor is controlled by said feed back device and wherein the work piece is moved into said die by one of said punches.

13. A cold forging apparatus for performing multiple functions at a single station to form complex shapes, said apparatus according to Claim 12 in which said first inner punch is surrounded by said first outer punch and in sliding engagement therewith.

14. A cold forging apparatus for performing multiple functions at a single station to form complex shapes, said apparatus according to Claim 13 in which each said inner punches are surrounded by one of said outer punches and is in sliding contact therewith.

15. A cold forging apparatus for performing multiple functions at a single station to form complex shapes, said apparatus according to Claim 14 in which said conveyor includes a first

pivot assembly and a moveable robot arm having an end effector fixed to one end thereof and an opposite end of said robot arm attached to said pivot assembly for rotation about a third axis and means including a servo actuator for rotating said robot arm about said third axis in response to movement of said servo actuator and wherein said movement of said servo actuator is controlled by said feed back device.

16. A cold forging apparatus for performing multiple functions at a single station to form complex shapes, said apparatus according to Claim 15 wherein said means including a servo actuator for rotating said robot arm includes a crank arm operatively connected at one end thereof to said servo actuator and at its opposite end to said robot arm.

17. A cold forging apparatus for performing multiple functions at a single station to form complex shapes, said apparatus according to Claim 16 in which said third axis is parallel to said first and second axes.

18. A cold forging apparatus for performing multiple functions at a single station to form complex shapes, said apparatus according to Claim 17 in which said end effector includes first and second carrier elements with said first carrier element fixed to said robot arm and said second carrier element pivotally attached to said first carrier and said first and second carrier elements adapted to receive a work piece therebetween in slidable engagement therewith and adapted to position the work piece adjacent to said die for insertion therein by one of said punches.

19. A cold forging apparatus for performing multiple functions at a single station to form complex shapes, said apparatus according to Claim 18 which includes a storage tray for forged products and in which said second carrier element includes a concave surface and an outwardly extending finger and is adapted to receive a forged product pushed out of said die and onto said concave surface and to convey said forged product to said storage tray and means for engaging said outwardly extending finger to tilt said second carrier element to thereby deliver the forged product to said storage tray.

20. A cold forging apparatus for performing multiple functions at a single station to form complex shapes, said apparatus according to Claim 19 which includes means for biasing said second carrier element into a closed position with respect to said first carrier element to thereby form a generally circular opening therebetween for receiving a work piece and which said biasing means is an offset weight.

21. A cold forging apparatus for performing multiple functions at a single station to form complex shapes, said apparatus according to Claim 19 which includes means for biasing said second carrier element into a closed position with respect to said first carriage element to thereby form a generally circular opening therebetween for receiving a work piece and in which said biasing means is a spring.

22. A cold forging apparatus for performing multiple functions at a single station to form complex shapes, said apparatus according to Claim 12 in which said robot arm is generally J-shaped.